

Passive Active L/S-Band Microwave Aircraft Sensor for Ocean Salinity Measurement

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Introduction

- Sea Surface Salinity is key ocean geophysical parameter that is “missing” from spaceborne remote sensing measurements of global ocean
 - deep and tropical ocean circulation
- Feasibility of sea surface salinity remote sensing
 - Klein and Swift (78), Swift and McIntosh (83), Ellison et al. (98)
 - Airborne proof-of-concept experiments
 - Blume et al. ‘78, Lagerloef et al. ‘95, Miller et al. ‘98, LeVine et al. ‘98
- Ocean Microwave emissivity depends on
 - surface dielectric constant (related to sea surface salinity)
 - surface roughness
 - sea surface temperature
 - others? (e.g. foam)

Introduction (cont'd)

- At L-Band (1.4GHz), Ellison et al.
 - $\Delta T_b \sim 0.8^\circ\text{K}$ per PSU ($>20^\circ\text{C}$)
 - $\Delta T_b \sim 0.4^\circ\text{K}$ per PSU (5°C)
 - to achieve 0.1 to 0.2 PSU accuracy required for global ocean studies
 - require $\sim 0.1^\circ\text{K}$ ΔT accuracy
- To determine effects of surface roughness
 - use of active radar sensor with near simultaneous measurements at frequencies close to radiometers
- Additional evaluation of benefit
 - dual polarization (V,H)
 - dual frequencies (L/S-Band)
- Motivation to develop a high accuracy, active/passive L/S-Band airborne instrument



L and S-Band Aircraft Radiometer Characteristics

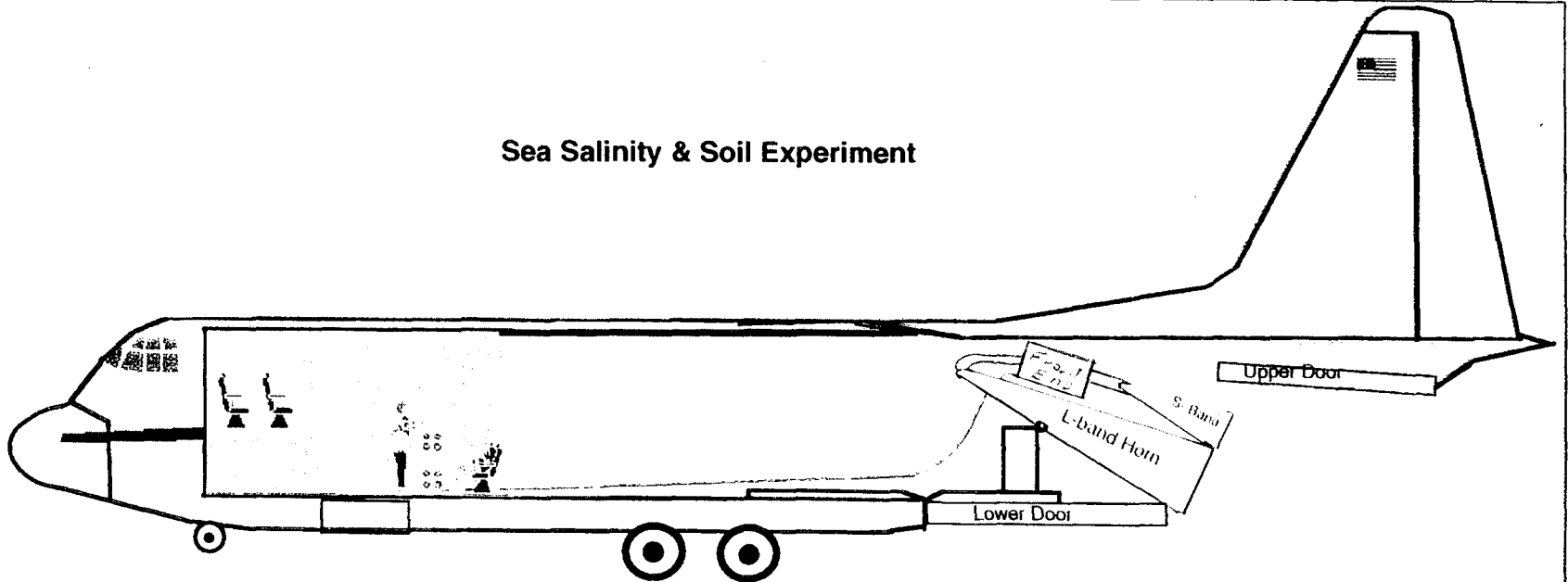
Frequencies	1.41 and 2.69 GHz
Antenna Beam Efficiency	> 90%
Polarization	Horizontal & Vertical
Beam Incidence Angle	38°
Spatial Resolution (@ 1.2 km)	0.7 km
Dicke Switch Rate	80 Hz
RMS Noise per Footprint	0.15 K
Absolute Calibration Accuracy	1.0 K
Calibration Stability	0.1 K



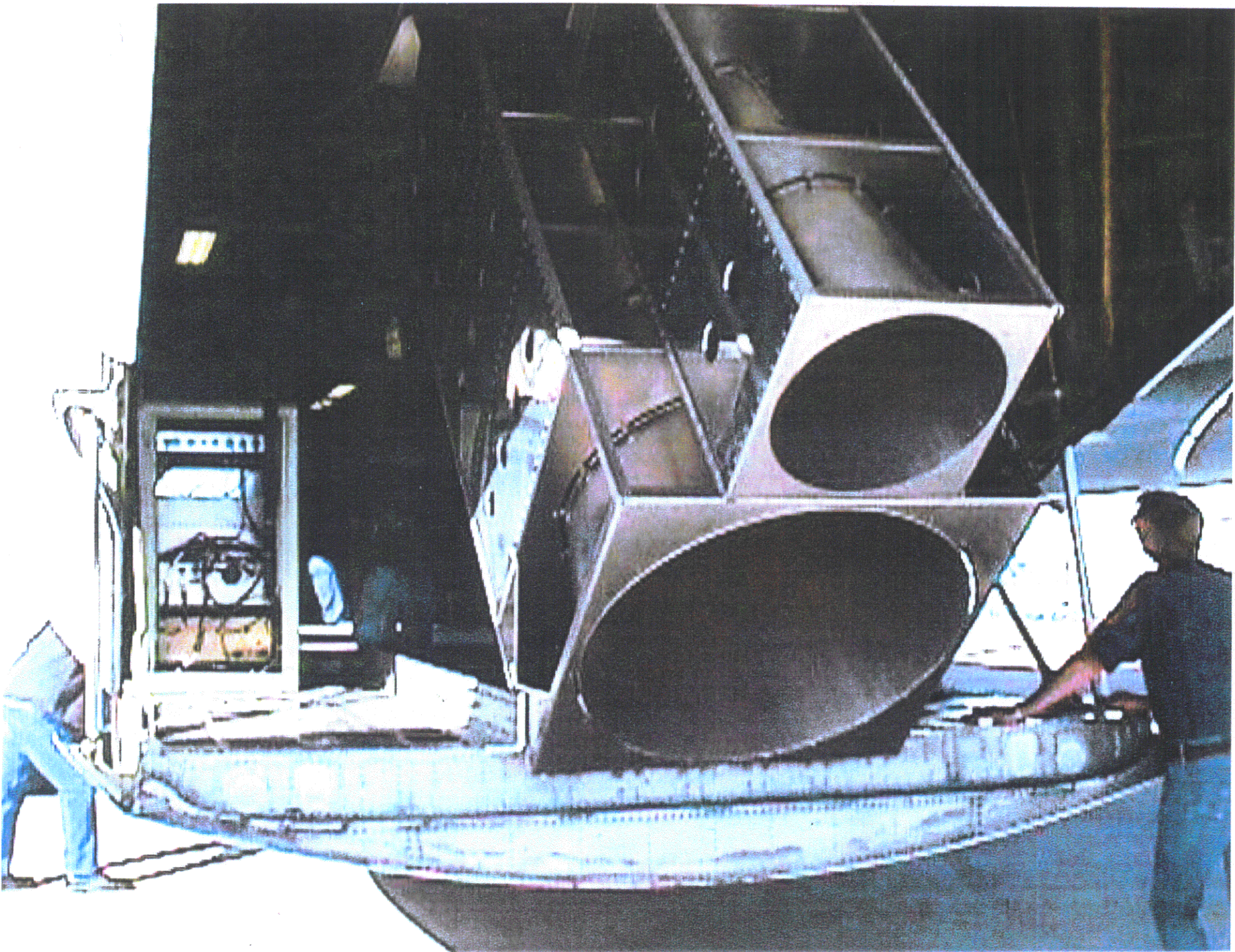
L and S-Band Aircraft Radar Characteristics

Frequencies	1.26 and 3.15 GHz
Polarization	HH, VH, VV
Beam Incidence Angle	38°
Spatial Resolution (@ 1.2 km)	0.7 km
Transmit Power and Duty cycle	5 Watts and 8%
Pulse Repetition Rate (PRF)	2.8 kHz
Signal to Noise Ratio per pixel	> 15 dB
Sensitivity	0.2 dB
Calibration Stability	0.1 dB

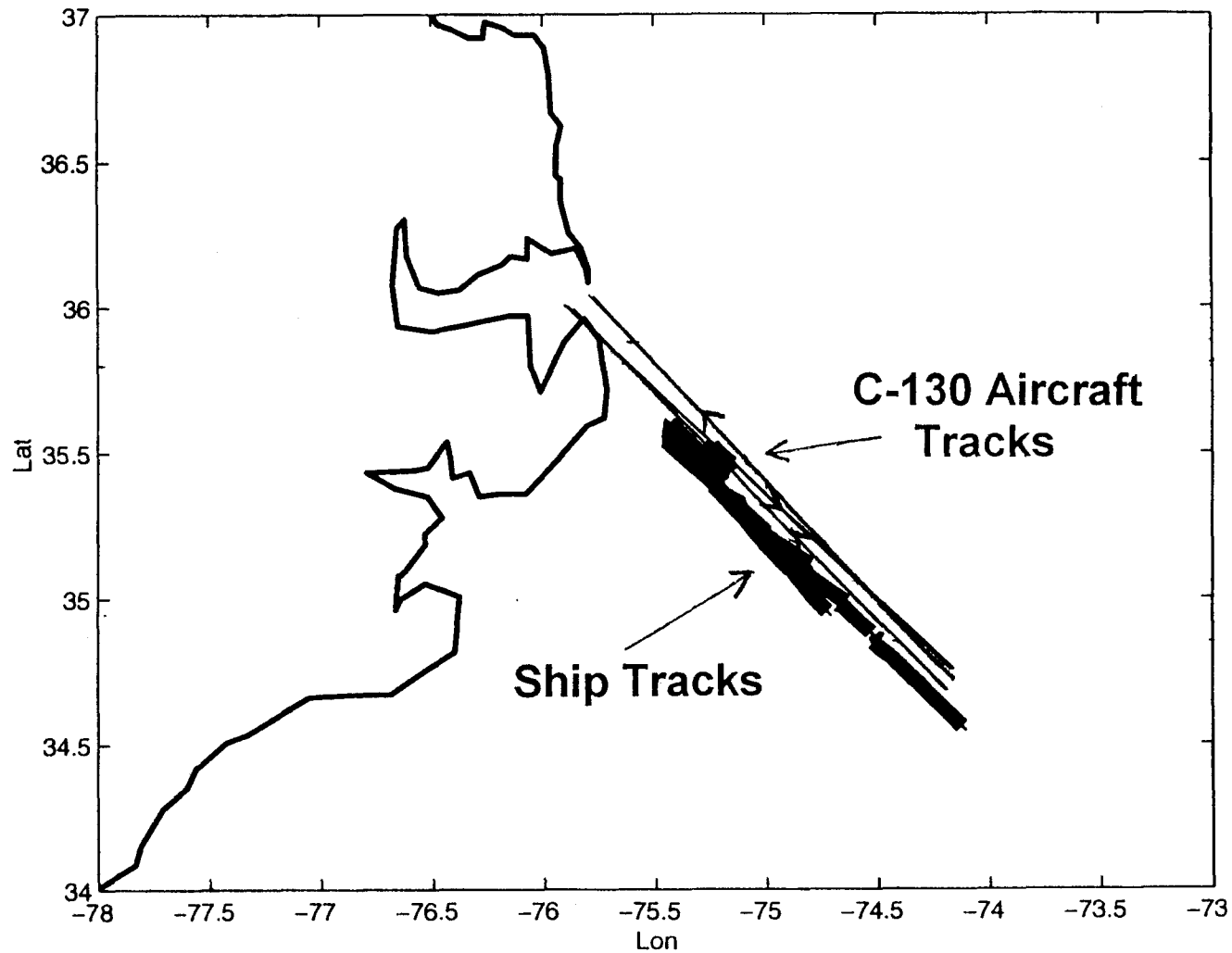
The diagram illustrates the Sea Salinity & Soil Experiment (SSSE) payload configuration on a P-3 aircraft. The aircraft is shown in profile, with the SSSE payload mounted on the lower fuselage. The payload consists of a large rectangular structure with various instruments and antennas. Labels indicate the 'Upper Door' and 'Lower Door' locations, the 'L-band Horn' antenna, and the 'S-Band' antenna. The aircraft's tail fin features an American flag. The text 'Sea Salinity & Soil Experiment' is prominently displayed above the aircraft.

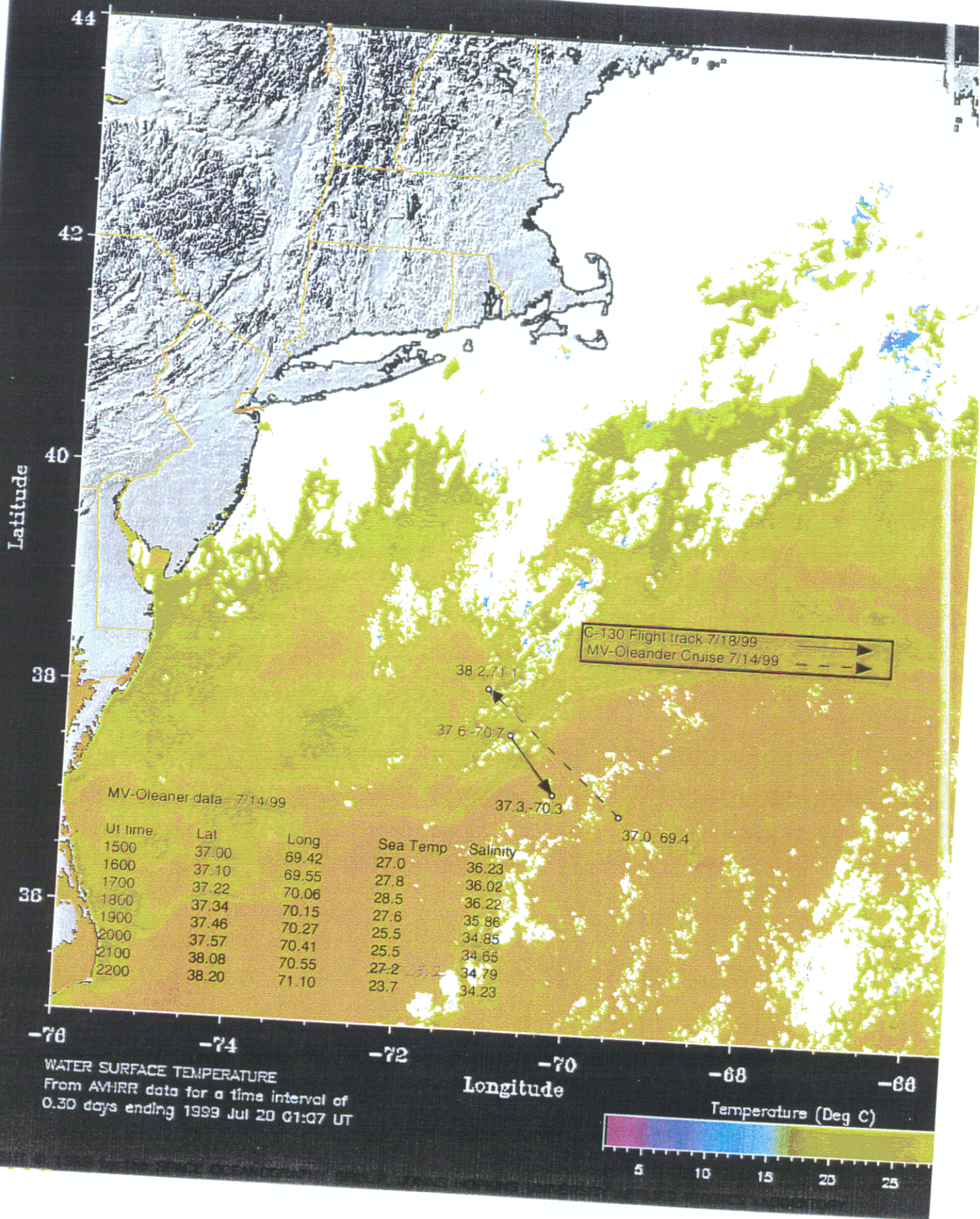






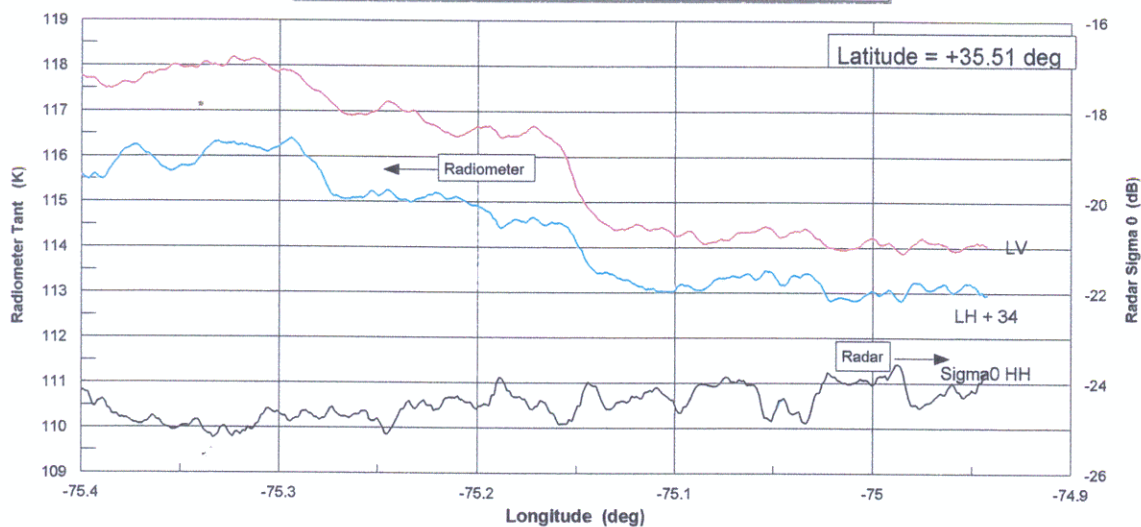
Cape Hatteras Ship and C-130 Tracks Over Gulf Stream on July 18, 1999



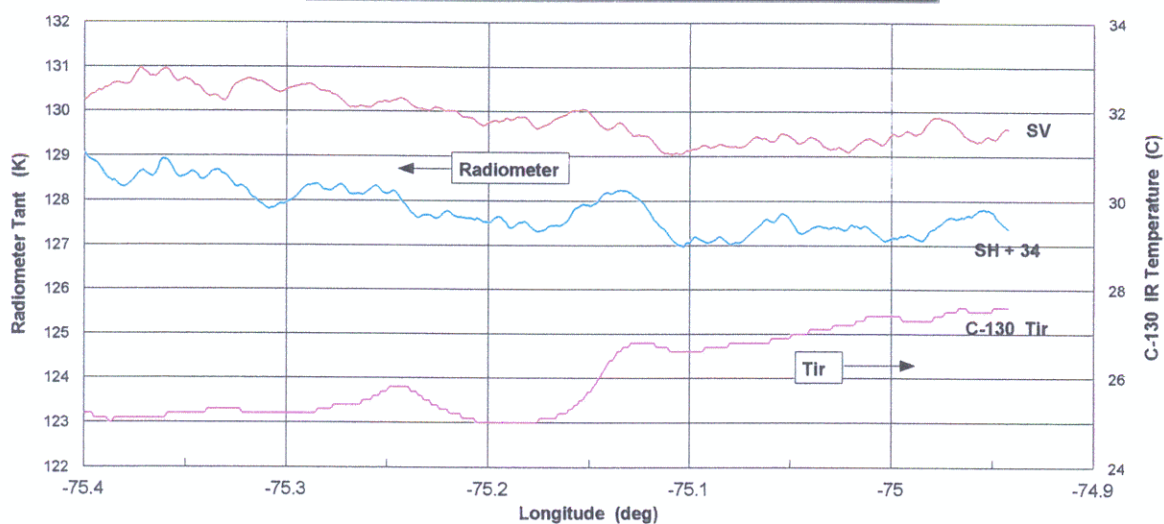


Ocean Data over Gulf Stream at 1529 EDT on July 18,

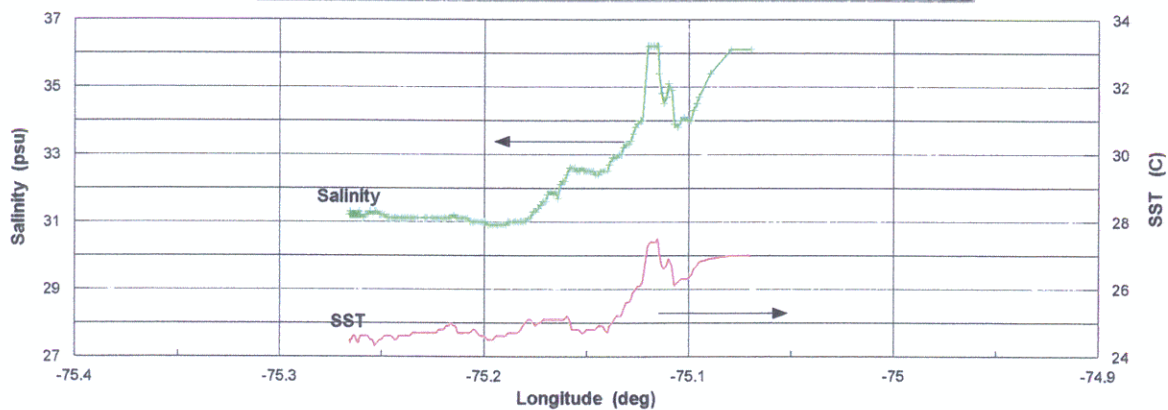
L-band Data 1529 18Jul 99 E-W



S-band Radiometer Data & C-130 Tir

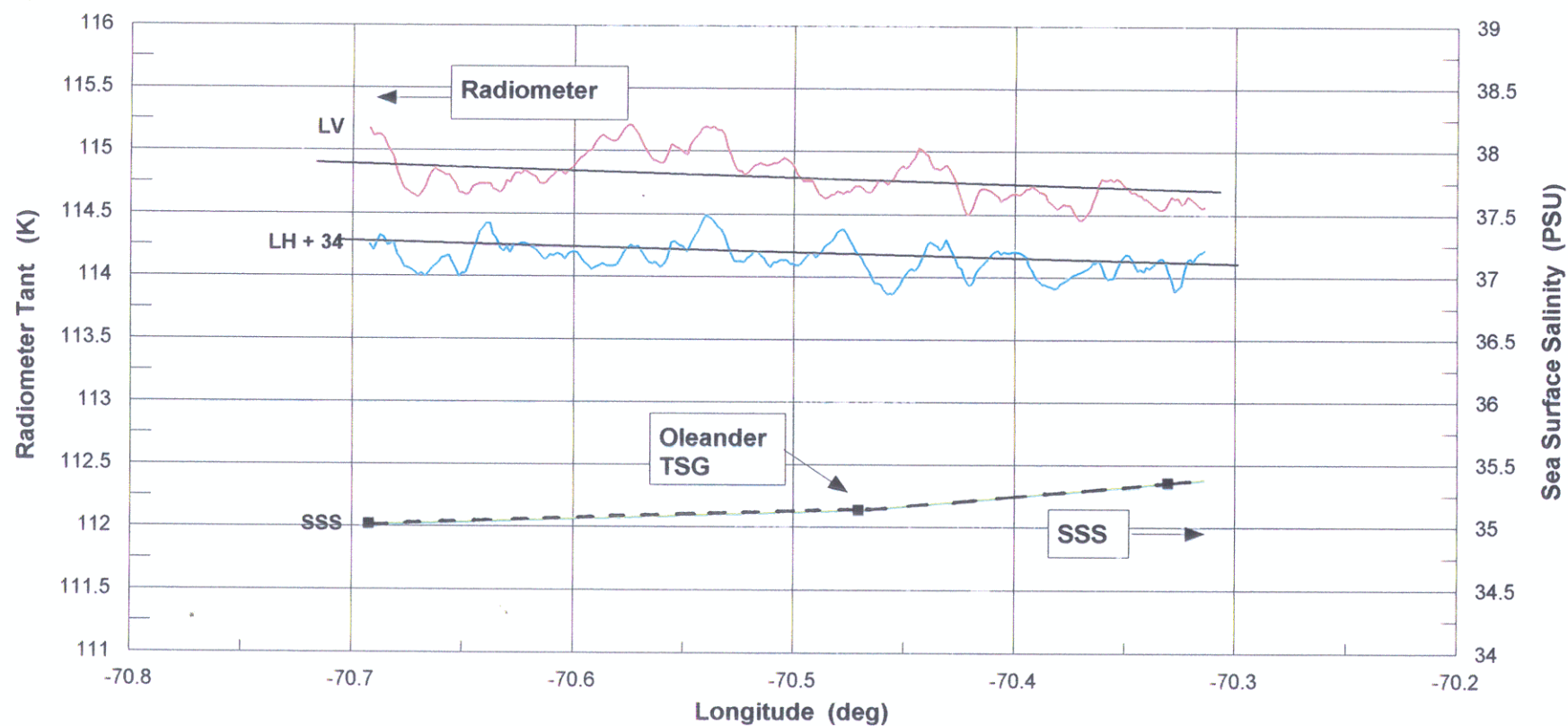


Salinity and SST from Cape Hatteras ship



Open Ocean Data along the track of M/V Oleander July 18, 1999

L-band Radiometer & Salinity





OCEAN SALINITY AIRCRAFT INSTRUMENT

Summary of PALS July 1999 Ocean Measurements

- **Over the Gulf Stream, large changes in the brightness temperature, ~ 3 K, were measured on all runs due to the large changes in the Salinity of ~ 5 PSU. There was good agreement with the TSG data from the Cape Hatteras.**
- **In the open ocean, a small change in the brightness temperature of ~ -0.2 K was measured on July 18th, which is consistent with the TSG data of a 0.4 PSU increase from the M/V Oleander**
- **Some problems with the ocean measurements**
 - **Near continuous RFI at S-band, minimum on Sunday, 18 July, No significant problem at L-band**
 - **Sun glint is a concern, and observations must be planned to minimize the effects**



OCEAN SALINITY AIRCRAFT INSTRUMENT

- JPL has built a dual polarized microwave L and S-band active and passive aircraft instrument for precision ocean salinity measurements
- This will be the first instrument of this kind to provide accurate active and passive measurements at L and S-bands
- Will provide data to improve existing radiative transfer and backscatter models of ocean surfaces
- Will develop improved algorithms for salinity for testing in models and validation of future space instruments